APPENDIX D- LITERATURE REVIEW

1. INTRODUCTION

During scoping for the proposed Salmon Salvage Project, George Sexton submitted a comment letter, on behalf of multiple organizations and individuals, which included 27 attachments of various articles and publications, with excerpts included in his letter. Two subsequent addendums were sent from Kimberly Baker including ten total additional attachments. Each article was reviewed by the appropriate Forest Service resource specialist and their responses are shown below. The attachments are in the public participation folder of the project file available at the Salmon/Scott River Ranger District Office of the Klamath National Forest (KNF), located in Fort Jones, CA.

2. GENERAL RESPONSE

The majority of articles submitted relate to the "scientific controversy" regarding post-fire logging. The Forest Service acknowledges that there is a large amount of information available about the positive effects of wildfires and the potential negative effects from post-fire logging. Exhaustive reviews of every literature citation are not required by the National Environmental Policy Act (NEPA). The "hard look" requirement under NEPA was met by the Salmon Salvage Project Environmental Assessment (EA) in a number of ways. Direct, indirect, and cumulative effects of no action and 2 action alternatives were described in detail in the EA and in supporting documentation. Specifically, each specialist's report included an "environmental consequences" section describing the effects of all three alternatives on the relevant resource of concern. The analyses completed in the specialist reports take into consideration, and make conclusions based on, research, science, reports, models, monitoring and site-specific information as it was available, in conjunction with scientific recommendations regarding the management of, and effects of, the project activities on the relevant resource.

A draft Environmental Assessment has been prepared. The Forest Service considered both broad and site-specific effects of the proposed action, and no significant direct, indirect or cumulative effects to any resources were identified. The Proposed Action complies with all current laws, regulations and Forest Service policy and meets the Klamath National Forest Land and Resource Management Plan (Forest Plan) standards and guidelines. The Salmon Salvage Project EA summarizes and includes by reference all specialist report findings and other related analyses to clearly demonstrate that the Forest took the "hard look" required by NEPA to reach a FONSI.

Sexton Attachment #1 Baker Addendum Attachment #1:

Donato, D. C., J. B. Fontaine, J. L. Campbell, W. D. Robinson, J. B. Kauffman, and B. E. Law. 2006. **Post-Wildfire Logging Hinders Regeneration and Increases Fire Risk** published in Sciencexpress, January 5, 2006.

"Our data show that post-fire logging, by removing naturally seeded conifers and increasing surface fuel loads, can be counterproductive to goals of forest regeneration and fuel reduction. In addition, forest regeneration is not necessarily in crises across all burned forest landscapes. The results presented here suggest that post-fire logging may conflict with ecosystem recovery goals."

FS RESPONSE TO SEXTON #1:

From Newton et al:

“Donato et al. (1) recently concluded that logging 2 to 3 years after wildfire kills natural regeneration and increases fire risk. The research may make a valuable contribution, but the study lacks adequate context and supporting information to be clearly interpreted. Here, we discuss the papers methods and conclusions in the context of relevant management objectives and the forestry knowledge base concerning natural regeneration processes, mortality from logging, and fuel accumulations in southwestern Oregon and northwestern California.

Donato et al. (1) made inferences about natural regeneration processes, mortality from logging, and fuel accumulations without presenting key information regarding (i) agency postfire management directives for reforestation or downed wood levels (2), (ii) implications of delays in postfire plan implementation, or (iii) important environmental and disturbance descriptors such as plant associations, fire intensity, seed tree proximity, and weather patterns. Results from their study cannot be readily extrapolated because it was a short-term observational study of site-specific forest operations governed by agency management objectives. Other management plans, operations, or conditions could yield different results (3). In the case of the 2002 Biscuit Fire, logging was postponed for 2 years, allowing more seeds to germinate and increasing seedling exposure to injury during logging (4).

Donato et al. cite a lack of scientific data regarding the management of public forests after large fires. However, it should be noted that conifer reforestation (planted and natural) and vegetation ecology have been widely studied in the region. Studies show variable responses with plant association, competing vegetation, local climate, soils, and other factors (5, 6). Hobbs et al. (5) provide a synthesis of 13 years of research in southern Oregon and northern California. Fewer studies have examined reforestation after wildfire, especially over longer periods (4, 7–9), but damage to natural regeneration after delayed salvage logging was reported more than 50 years ago (4, 8)…”

Sexton Attachment #2:

Odion et al. **Fire Severity in Conifer Forests in the Sierra Nevada, California**, published in Ecosystems, 2006, 9, 1177-1189.

“Natural disturbances are an important source of environmental heterogeneity that has been linked to species diversity in ecosystems. However, spatial and temporal patterns of disturbances are often evaluated separately. Consequently, rates and scales of existing disturbance processes and their effects on biodiversity are often uncertain. We have studied both spatial and temporal patterns of contemporary fires in the Sierra Nevada Mountains, California, USA. Patterns of fire severity were analyzed for conifer forests in the three largest fires since 1999. These fires account for most cumulative area that has burned in recent years. They burned relatively remote areas where there was little timber management. To better characterize high-severity fire, we analyzed its effect on the survival of pines. We evaluated temporal patterns of fire since 1950 in the larger landscapes in which the three fires occurred. Finally, we evaluated the utility of a metric for the effects of fire suppression. Known as Condition Class it is now being used throughout the United States to predict where fire will be uncharacteristically severe. Contrary to the assumptions of fire management, we found that high-severity fire was uncommon. Moreover, pines were remarkably tolerant of it. The wildfires helped to restore landscape structure and heterogeneity, as well as producing fire effects associated with natural diversity. However, even with large recent fires, rates of burning are relatively low due to modern fire management. Condition Class was not able to predict patterns of high-severity fire. Our findings underscore the need to conduct more comprehensive assessments of existing disturbance regimes and to determine whether natural disturbances are occurring at rates and scales compatible with the maintenance of biodiversity.”

FS RESPONSE TO SEXTON #2:

This paper is about the errors of defining condition classes to forested areas and dispelling the link between historical active fire suppression and increases in fire intensities in the Sierra Nevada Mountains. This paper does not relate to the Salmon Salvage Project, as it is not located in the Sierra Nevada Mountains, condition class is not used in project analysis, and the paper does not discuss the effects of salvage logging.

Sexton Attachment #3:

Beschta et al. **Post-fire Management on Forested Public Land of the Western United States**, Conservation Biology, Volume 18, No.4 August 2004 pages 957-967.

"Forest ecosystems in the western United States evolved over many millennia in response to disturbances such as wildfires. Land use and management practices have altered these ecosystems, however, including fire regimes in some areas. Forest ecosystems are especially vulnerable to post-fire management practices because such practices may influence forest dynamics and aquatic systems for decades to centuries. Thus, there is an increasing need to evaluate the effect of post-fire treatments from the perspective of ecosystem recovery. We examined, via the published literature and our collective experience, the ecological effects of some common post-fire treatments. Based on this examination, promising post-fire restoration measures include retention of large trees, rehabilitation of firelines and roads, and, in some cases, planting of native species. The following practices are generally inconsistent with effort to restore ecosystem functions after fire: seeding exotic species, livestock grazing, placement of physical structures in and near stream channels, ground-based post-fire logging, removal of large trees, and road construction. Practices that adversely affect soil integrity, persistence or recovery of native species, riparian functions, or water quality generally impede ecological recovery after fire. Although research provides a basis for evaluating the efficacy of post-fire treatments, there is a continuing need to increase our understanding of the effects of such treatments within the context of societal and ecological goals for forested public lands of the western United States."

FS RESPONSE TO SEXTON #3:

This paper from Beschta et al highlights some concerns the public and some scientific communities have about the logging impacts in a post-fire landscape. The Salmon Salvage Project was designed to mitigate these impacts. Riparian Reserves are buffered except where roadside hazard trees would be cut. Best management practices (BMP) to mitigate impacts on the physical environment (i.e. soils, hydrology and geology) are required to implement a treatment on the ground. Refer to site specific design features listed in the environmental assessment.

The paper also lists seeding exotic species, grazing, placing physical structures in/near streams, ground-based post-fire logging, removal of large trees, and road construction as being generally inconsistent with efforts to restore ecosystem function after fire. No exotic species seeding, grazing, in stream structures, or new permanent or temporary road construction is being proposed in the Salmon Salvage Project. Of the approximately 330 acres of proposed salvage harvest a small percentage (5%) will be mechanically skidded with the other acreage helicopter and cable yarded. The overall acreage of proposed salvage harvest comprises less than 3 % of the Salmon River Complex acreage. Many large trees will be retained as no salvage will occur in streamside Riparian Reserves (only roadside hazard tree reduction will occur).

Please see EA section 2.5 for alternatives considered but eliminated from detailed study.

Sexton Attachment #4:

Thompson, JR, TA Spies, LM Ganio, 2007. **Reburn Severity in Managed and Unmanaged Vegetation in a Large Wildfire.** Proceedings of the National Academy of Sciences.

"found that mixed-conifer and mixed evergreen-hardwood forests that were salvage logged (and planted) following the 1987 Silver Fire in the Siskiyou National Forest experienced higher severity re-burn in the 2002 Biscuit Fire than did stands in the Silver Fire (subsequently burned in the Biscuit Fire) that were not subject to salvage logging and artificial plantation establishment. Thompson, JR, TA Spies, LM Ganio, 2007. Reburn Severity in Managed and Unmanaged Vegetation in a Large Wildfire. Proceedings of the National Academy of Sciences. The abstract states: Debate over the influence of post wildfire management on future fire severity is occurring in the absence of empirical studies. We used satellite data, government agency records, and aerial photography to examine a forest landscape in southwest Oregon that burned in 1987 and then was subject, in part, to salvage-logging and conifer planting before it reburned during the 2002 Biscuit Fire. Areas that burned severely in 1987 tended to reburn at high severity in 2002, after controlling for the influence of several topographical and biophysical covariates. Areas unaffected by the initial fire tended to burn at the lowest severities in 2002. Areas that were salvage-logged and planted after the initial fire burned more severely than comparable unmanaged areas, suggesting that fuel conditions in conifer plantations can increase fire severity despite removal of large woody fuels."

FS RESPONSE TO SEXTON #4:

First, reforestation is not part of the Salmon Salvage Project. Second, of the 7,580 acres of plantations that are in the fire perimeter only 35% were burned severely enough to warrant additional reforestation activities based on management objectives for those stands.

A fire of a given intensity (for example four-foot flames) would result in a different severity classification in the uncut and partial cut forests compared to the plantations. Such a fire would kill the same sized trees in both locations. In the forest areas, young trees up to saplings and small poles might be killed in the understory, but there would still be an overstory canopy that hid this from the aerial photos used- so it was classified as 'low' severity. The same fire, killing the same sized trees in the plantation, without an overstory, would receive a classification of high severity. This does not mean the fires were more intense in the plantations nor does it mean that the plantations are more combustible (Weatherspoon & Skinner, 1995).

Young forests, whether naturally or artificially regenerated, may be vulnerable to positive feedback cycles of high severity fire, creating more early successional vegetation (Thompson, Spies, & L.M. Ganio, 2007).

Regeneration units (plantations) burned similarly to the surrounding forest with the exception of those plantations that had not had fuels treatments (planted through the slash). Fire often did not carry through the units that had been prescribe burned (Weatherspoon & Skinner, 1995).

Sexton Attachment #5:

Hutto, R.L. 1995, **Composition of Bird Communities Following Stand Replacement Fires in Northern Rocky Mountain Conifer Forests.** Conservation Biology 9: 1041-1058.

"During the two breeding seasons immediately following the numerous and widespread fires of 1988, I estimated bird community composition in each of 34 burned-forest sites in western Montana and northern Wyoming. I detected an average of 45 species per site and a total of 87 species in the sites combined. A compilation of these data with bird-count data from more than 200 additional studies conducted across 15 major vegetation cover types in the northern Rocky Mountain region showed that 15 bird species are generally more abundant in early post-fire communities than in any other major cover type occurring in the northern Rockies. One bird species (Black-backed Woodpecker, Picoides arcticus) seems to be nearly restricted in its habitat distribution to standing dead forests created by stand-replacement fires. Bird communities in recently burned forests are different in composition from those that characterize other Rocky Mountain cover types (including early-successional clearcuts) primarily because members of three feeding guilds are especially abundant therein: woodpeckers, flycatchers, and seedeaters. Standing, fire-killed trees provided nest sites for nearly two-thirds of 31 species that were found nesting in the burned sites. Broken-top snags and standing dead aspens were used as nest sites for cavity-nesting species significantly more often than expected on the basis of their relative abundance. Moreover, because nearly all of the broken-top snags that were used were present before the fire, forest conditions prior to a fire (especially the presence of snags) may be important in determining the suitability of a site to cavity-nesting birds after a fire. For bird species that were relatively abundant in or relatively restricted to burned forests, stand replacement fires may be necessary for long-term maintenance of their populations.

Unfortunately, the current fire policy of public land-management agencies does not encourage maintenance of stand-replacement fire regimes, which may be necessary for the creation of conditions needed by the most fire-dependent bird species. In addition, salvage cutting may reduce the suitability of burned-forest habitat for birds by removing the most important element--standing, fire-killed trees-needed for feeding, nesting, or both by the majority of bird species that used burned forest."

Sexton Attachment #6:

Hutto, R.L. 2006. **Toward meaningful snag-management guidelines for post-fire salvage logging in North American conifer forests.** Conservation Biology 20: 984-993.

“The bird species in western North America that are most restricted to, and therefore most dependent on, severely burned conifer forests during the first years following a fire event depend heavily on the abundant standing snags for perch sites, nest sites, and food resources. Thus, it is critical to develop and apply appropriate snag-management guidelines to implement post-fire timber harvest operations in the same locations. Unfortunately, existing guidelines designed for green-tree forests cannot be applied to post-fire salvage sales because the snag needs of snag-dependent species in burned forests are not at all similar to the snag needs of snag-dependent species in green-tree forests. Birds in burned forests have very different snag retention needs from those cavity-nesting bird species that have served as the focus for the development of existing snag-management guidelines. Specifically, many post-fire specialists use standing dead trees not only for nesting purposes but for feeding purposes as well. Woodpeckers, in particular, specialize on wood-boring beetle larvae that are superabundant in fire-killed trees for several years following severe fire. Species such as the Black-backed woodpecker (Picoides arcticus) are nearly restricted in their habitat distribution to severely burned forests. Moreover, existing post-fire salvage-logging studies reveal that most post-fire specialist species are completely absent from burned forests that have been (even partially) salvage logged. I call for the long-overdue development and use of more meaningful snag retention guidelines for post-fire specialists, and I note that the biology of the most fire-dependent bird species suggests that even a cursory attempt to meet their snag needs would preclude post-fire salvage logging in those severely burned conifer forests wherein the maintenance of biological diversity is deemed important.

Sexton Attachment #7:

Kotliar, N.B., S.J. Hejl, R.L. Hutto, V. Saab, C.P. Melcher, and M.E. McFadzen. 2002. **Effects of fire and post-fire salvage logging on avian communities in conifer-dominated forests of the western United States.** In: George, T.L. and D.S. Dobkin. Effects of habitat fragmentation on birds in western landscapes: contrasts with paradigms from the eastern United States. Studies in Avian Biology No. 25. Camarillo, CA: Cooper Ornithological Society. p. 49-64.

“Historically, fire was one of the most widespread natural disturbances in the western United States. More recently, however, significant anthropogenic activities, especially fire suppression and silvicultural practices, have altered fire regimes; as a result, landscapes and associated communities have changed as well. Herein, we review current knowledge of how fire and post-fire salvaging practices affect avian communities in (1) burned vs. unburned forests, and (2) un-salvaged vs. salvage-logged burns. We also examine how variation in burn characteristics (e.g. severity, age, size) and salvage logging can alter avian communities in burns. Of the 41 avian species observed in three or more studies comparing early post-fire and adjacent unburned forests, 22% are consistently more abundant in burned forests, 34% are usually more abundant in unburned forests, and 44% are equally abundant in burned and unburned forests or have varied responses. In general, woodpeckers and aerial foragers are more abundant in burned forests, whereas most foliage-gleaning species are more abundant in unburned forests. Bird species that are frequently observed in stand-replacement burns are less common in understory burns; similarly, species commonly observed in unburned forests often decrease in abundance with increasing burn severity. Granivores and species common in open canopy forests exhibit less consistency among studies. For all species, responses to fire may be influenced by a number of factors including burn severity, fire size and shape, proximity to unburned forests, pre- and post- fire cover types, and time since fire. In addition, post-fire management can alter species’ responses to burns. Most cavity-nesting species do not use severely salvaged burns, whereas some cavity-nesters persist in partially salvaged burns. Early post-fire specialists, in particular, appear to prefer un-salvaged burns. We discuss several alternatives to severe salvage-logging that will help provide habitat for cavity nesters.”

Sexton Attachment #8:

Kotliar et al. 2002**. Fire on the Mountain: Birds and Burns in the Rocky Mountains.** USDA Forest Service Gen. Tech. Rep. PSW-GTR-191. 2005. Presented at the Third International Partners in Flight Conference, March 20-24, 2002, Asilomar Conference Grounds, California.

Sexton Attachment #10:

Smucker et. al. 2005. **Changes in Bird Abundance After Wildfire: Importance of Fire Severity and Time Since Fire.** Ecological Applications, 15(5), 2005, pp.1535–1549. Ecological Society of America.

"Fire can cause profound changes in the composition and abundance of plant and animal species, but logistics, unpredictability of weather, and inherent danger make it nearly impossible to study high-severity fire effects experimentally. We took advantage of a unique opportunity to use a before–after/control–impact (BACI) approach to analyze changes in bird assemblages after the severe fires of 2000 in the Bitterroot Valley, Montana. Observers surveyed birds using 10-minute point counts and collected vegetation data from 13 burned and 13 unburned transects for five years before fire and three years after fire. We compared changes in vegetation variables and relative bird abundance from before to after fire between the set of points that burned and the set of points that did not burn. The magnitude of change in vegetation variables from before to after fire increased with fire severity. The relative abundances of nine bird species showed significantly greater changes from before to after fire at burned points compared with unburned points. Moreover, when burned points were separated by whether they burned at low, moderate, or high severity, an additional 10 species showed significant changes in relative abundance from before to after fire at one or more severities. Overall, almost twice as many bird species increased as decreased significantly in response to fire. We also found changes in abundance between one year after and two years after fire for most species that responded to fire. Thus, species that have been termed ''mixed responders'' in the literature appear to be responding differently to different fire severities or different time periods since fire, rather than responding variably to the same fire conditions.

These findings underscore the importance of fire severity and time since fire and imply that both factors must be considered to understand the complexities of fire effects on biological communities. Because different bird species responded positively to different fire severities, our results suggest a need to manage public lands for the maintenance of all kinds of fires, not just the low-severity, understory burns that dominate most discussions revolving around the use of fire in forest restoration."

Sexton Attachment #11:

Kotliar et al, 2007**. Avifaunal Responses To Fire in Southwestern Montane Forests Along a Burn Severity Gradient.** Ecological Applications, 17(2) 2007, pp. 491–507 by the Ecological Society of America.

"The effects of burn severity on avian communities are poorly understood, yet this information is crucial to fire management programs. To quantify avian response patterns along a burn severity gradient, we sampled 49 random plots (2001–2002) at the 17 351-ha Cerro Grande Fire (2000) in New Mexico, USA. Additionally, pre-fire avian surveys (1986– 1988, 1990) created a unique opportunity to quantify avifaunal changes in 13 pre-fire transects (resampled in 2002) and to compare two designs for analyzing the effects of unplanned disturbances: after-only analysis and before–after comparisons. Distance analysis was used to calculate densities. We analyzed after-only densities for 21 species using gradient analysis, which detected a broad range of responses to increasing burn severity: (I) large significant declines, (II) weak, but significant declines, (III) no significant density changes, (IV) peak densities in low- or moderate-severity patches, (V) weak, but significant increases, and (VI) large significant increases.

Overall, 71% of the species included in the after-only gradient analysis exhibited either positive or neutral density responses to fire effects across all or portions of the severity gradient (responses III–VI). We used pre/post pairs analysis to quantify density changes for 15species using before–after comparisons; spatiotemporal variation in densities was large and confounded fire effects for most species. Only four species demonstrated significant effects of burn severity, and their densities were all higher in burned compared to unburned forests. Pre- and post-fire community similarity was high except in high-severity areas. Species richness was similar pre- and post-fire across all burn severities. Thus, ecosystem restoration programs based on the assumption that recent severe fires in Southwestern ponderosa pine forests have overriding negative ecological effects are not supported by our study of post-fire avian communities. This study illustrates the importance of quantifying burn severity and controlling confounding sources of spatiotemporal variation in studies of fire effects. After-only gradient analysis can be an efficient tool for quantifying fire effects. This analysis can also augment historical data sets that have small samples sizes coupled with high non-process variation, which limits the power of before–after comparisons."

Sexton Attachment #21:

Saab et al. 200[8**]. <u>Nest-site selection by cavity-nesting birds in relation to salvage logging.</u>** Forest Ecology and Management (200[8])

"Large wildfire events in coniferous forests of the western United States are often followed by post-fire timber harvest. The long-term impacts of post-fire timber harvest on fire-associated cavity-nesting bird species are not well documented. We studied nest-site selection by cavity-nesting birds over a 10-year period (1994–2003), representing 1–11 years after fire, on two burns created by mixed severity wildfires in western Idaho, USA. One burn was partially salvaged logged (the Foothills burn), the other was primarily unlogged (the Star Gulch burn). We monitored 1367 nests of six species (Lewis's Woodpecker Melanerpes lewis, HairyWoodpecker Picoides villosus, Black-backed Woodpecker P. arcticus, Northern Flicker Colaptes auratus, Western Bluebird Sialia mexicana, and Mountain Bluebird S. currucoides). Habitat data at nest and non-nest random locations were characterized at fine (field collected) and coarse (remotely sensed) spatial scales.

Nest-site selection for most species was consistently associated with higher snag densities and larger snag diameters, whereas wildfire location (Foothills versus Star Gulch) was secondarily important. All woodpecker species used nest sites with larger diameter snags that were surrounded by higher densities of snags than at non-nest locations. Nests of Hairy Woodpecker and Mountain Bluebird were primarily associated with the unlogged wildfire, whereas nests of Lewis's Woodpecker and Western Bluebird were associated with the partially logged burn in the early years after fire. Nests of wood-probing species (Hairy and Black-backed Woodpeckers) were also located in larger forest patch areas than patches measured at non-nest locations. Our results confirm previous findings that maintaining clumps of large snags in post-fire landscapes is necessary for maintaining breeding habitat of cavity-nesting birds. Additionally, appropriately managed salvage logging can create habitat for some species of cavity-nesting birds that prefer more open environments. Our findings can be used by land mangers to develop design criteria for post-fire salvage logging that will reserve breeding habitat for cavity-nesting birds."

FS RESPONSE TO SEXTON #5,6,7,8,10,11, and 21:

The Forest Service does not refute that different species respond differently to different fire severities. This topic is addressed in the project *MIS Report Part II.* The Proposed Action was not designed to - nor would it - eliminate moderate or high severity burns.

Effects to other migratory and cavity nesting birds are discussed in Migratory Bird Report and MIS Report. Snags and hardwoods will be retained at or above KNF S&G levels after treatment. Important habitat components such as large snags will be retained in clumps and skips throughout the salvage treatments to provide for future habitat quality for birds that depend on snags.

Sexton Attachment #9:

Letter dated August 1, 2006 that appeared in *Science* vol.314 Oct. 6, 2006

"The effects of post-disturbance logging require careful consideration of whether to log at all, and if so, how to conduct such logging to minimize negative consequences. If we must conduct post-disturbance logging for timber production, stringent ecological safeguards must be in place to minimize impacts to terrestrial and aquatic ecosystems. When viewed through an ecological lens, a recently disturbed landscape is not just a collection of dead trees, but a unique and biologically rich environment that also contains many of the building blocks for the rich forest that will follow the disturbance."

FS RESPONSE TO SEXTON #9:

The Forest recognizes the importance of these ecosystems on the landscape. A watershed assessment for the North Fork of the Salmon River provides desired conditions for seral stages across the watershed. Desired conditions for early seral forest ecosystems range between 5-20% (North Fork Watershed Analysis, page 5-9). Based on existing vegetation data and vegetative burn severity data from the Salmon River Complex, the existing condition of early seral forest ecosystems within the fire perimeter is about 41%. Salvage logging and follow up reforestation activities prescribed in the Salmon Reforestation Project would accelerate a very small amount of the early seral condition, but overall would increase the diversity of seral stages and move it more in line with the desired condition for the landscape.

Furthermore the project has been carefully designed, including project design features and best management practices, to minimize negative consequences and protect aquatic and terrestrial ecosystems. The preceding Environmental Assessment includes the effects to various resources and documents the careful consideration given to the project design.

Sexton Attachment #12:

Lindenmayer and Noss, 2006. **Salvage Logging, Ecosystem Process, and Biodiversity Conservation.** Conservation Biology Volume 20, No. 4, 949–958. 2006.

“We summarize the documented and potential impacts of salvage logging—a form of logging that removes trees and other biological material from sites after natural disturbance. Such operations may reduce or eliminate biological legacies, modify rare post-disturbance habitats, influence populations, alter community composition, impair natural vegetation recovery, facilitate the colonization of invasive species, alter soil properties and nutrient levels, increase erosion, modify hydrological regimes and aquatic ecosystems, and alter patterns of landscape heterogeneity. These impacts can be assigned to three broad and interrelated effects: (1) altered stand structural complexity; (2) altered ecosystem processes and functions; and (3) altered populations of species and community composition. Some impacts may be different from or additional to the effects of traditional logging that is not preceded by a large natural disturbance because the conditions before, during, and after salvage logging may differ from those that characterize traditional timber harvesting.

The potential impacts of salvage logging often have been overlooked, partly because the processes of ecosystem recovery after natural disturbance are still poorly understood and partly because potential cumulative effects of natural and human disturbance have not been well documented. Ecologically informed policies regarding salvage logging are needed prior to major natural disturbances so that when they occur ad hoc and crisis-mode decision making can be avoided. These policies should lead to salvage-exemption zones and limits on the amounts of disturbance-derived biological legacies (e.g., burned trees, logs) that are removed where salvage logging takes place. Finally, we believe new terminology is needed. The word salvage implies that something is being saved or recovered, whereas from an ecological perspective this is rarely the case.”

FS RESPONSE TO SEXTON #12:

The above-mentioned literature acknowledges that:

“Effects are likely to vary over time and among and within vegetation types in response to the type, intensity, and periodicity of natural disturbance and disturbance by salvage logging.”

The paper also suggests that components of an ecologically defensible salvage policy should include certain measures. Although developing a management policy is beyond the scope of a project-level assessment, the project includes design features similar to those suggested, as paraphrased below:

***Exclude logging from some areas**.* The proposed action will treat with dead tree removal 334 acres of the 1,440 forested acres burned at moderate to high severity in the Salmon River Complex. There will be no salvage logging in hydrologic riparian reserves, inventoried roadless areas, or patches smaller than 10 acres within LSRs.

***Leave unburned or partially burned patches with the perimeter of a disturbed area**.* The proposed action is only targeting areas that burned at high vegetative burn severity; some areas of moderate severity, where adjacent to high severity areas, will be salvaged. The proposed action is to salvage 334 acres within the 14,779 acre fire perimeter, leaving the vast majority of the area untreated.

***Leave some fire damaged trees in the salvaged area**.* For the Salmon Salvage Project, snag and downed wood guidelines have been developed. Additionally, extensive areas of snags of all sizes would be left untreated in the project area.

Sexton Attachment #13:

Attached is an April 2006 open letter to Congress from an extremely long and impressive list of scientists, contending that:

“[N]o substantive evidence supports the idea that fire-adapted forests might be improved by logging after a fire. In fact, many carefully conducted studies have concluded just the opposite. Most plants and animals in these forests are adapted to periodic fires and other natural disturbances. They have a remarkable way of recovering literally rising from the ashes because they have evolved with and even depend upon fire.”

Sexton Attachment #26:

Attached is an October 2013 open letter to Congress from an extremely long and impressive list of scientists, contending that:

“consider what the science is telling us: that post-fire habitats created by fire, including patches of sever fire, are ecological treasures rather than ecological catastrophes, and that post-fire logging does far more harm than good to the nation’s public lands.”

FS RESPONSE TO SEXTON #13 and #26:

The above letters, attachment 13 and 26, were written to Congress in response to proposed legislation (HR 4200, 1526, 5188, and S. 2079); the letters contend that the legislation is misguided because it distorts or ignores recent scientific advances. They also contend that the legislation is crafted to ignore the science by waiving environmental reviews, and that failure of environmental review informed by science will inevitably lead to ecological and economic harm from post-disturbance logging. The letters are not relevant to the Salmon Salvage Project since the project includes environmental review supported by science as summarized in the EA.

Sexton Attachment #14:

Noss, Reed F. Ph.D., Jerry F. Franklin and , Ph.D., William Baker, Ph.D., Tania Schoennagel, Ph.D., and Peter B. Moyle, Ph.D**. Ecological Science Relevant to Management Policies for Fire-prone Forests of the Western United States.** Society for Conservation Biology, February 24, 2006.

Key Findings of this paper include the following:

- Research by both ecologists and foresters provides evidence that areas affected by large-scale natural disturbances often recover naturally.
- Post-fire logging does not contribute to ecological recovery; rather it negatively impacts recovery processes, with the intensity of such impacts depending upon the nature of the logging activity.
- Post-fire logging destroys much of whatever natural tree regeneration is occurring on a burned site.
- Evidence from empirical studies is that post-fire logging typically generates significant short- to mid-term increases in fine and medium fuels.
- There is no scientific or operational linkage between reforestation and post-fire logging; potential ecological impacts of reforestation are varied and may be either positive or negative depending upon the specifics of activity, site conditions, and management objectives. On the other hand, ecological impacts of post-fir logging appear to be consistently negative.

FS RESPONSE TO SEXTON #14:

Comment is discussing the benefit of ecology of western forest post large scale disturbances in particular regards to managing forests after wildfire. This paper appears to compile several ideas and research articles with no study area or methodology. In the introduction section of this paper are comparisons of treatments post fire detailed as High, Mixed, and Low severity burns however key findings are predominately based in High and Low severity burns. The severity from the Salmon Salvage project is detailed in the *Fuels Resource Report* and shows the mix of severity throughout the fire and project area. Salvage operations are planned to be implemented in a mix of stands that burned at high and moderate severity. Areas with both high and moderate severity will be untreated in the project area. The salvage treatments will impact less than 10 percent of the total fire perimeter with most of that percentage including roadside hazard acres. This comment discusses the “negative impacts from logging post fire.” Contrary to this is inconsistency in the cited document as the “Key Findings for Mixed Severity” states: “Scientific understanding of mixed-severity forest landscapes is limited, making it difficult to provide ecologically appropriate guidelines for restorative treatments.” This section goes on to state that post fire thinning and prescribed fire can be beneficial to restoration. Another portion of the comment states that “post fire logging destroys much of whatever natural tree regeneration was occurring on a burned site”. Areas surrounding harvest that will continue to provide a seed source for regeneration plus reforestation activities are planned post-harvest and fuels treatment (*Silviculture Report*). Lastly the comment discusses the unknown of “Scientific or operational linkage to reforestation and salvage logging” and “the ecological impacts of reforestation are varied and may be positive or negative …” and states that the USFS should acknowledge the limited science and linkage of this particular strategy to salvage log. However, the planned fuels treatment post logging has a per acre fuel load reduction to show positive results for the chance to reforest/ manage in the future. Furthermore, project design features from fuels, soils, wildlife, hydrology, botany, and other disciplines embedded in this Environmental Analysis are all designed to help achieve positive results for the future in this project area.

Sexton Attachment #15 Baker Addendum Attachment #1-4:

Karr, J. R., J. J. Rhodes, G. W. Minshall, F. R. Hauer, R. L. Beschta, C. A. Frissel, and D. A. Perry. 2004. **The Effects of Post-fire Salvage Logging on Aquatic Ecosystems of the American West.** Bioscience 54(11): 1029-1035. *The authors found that:*

- Post-fire salvage logging generally damages soils by compacting them, by removing vital organic material, and by increasing the amount and duration of topsoil erosion and runoff (Kattleman 1996), which in turn harms aquatic ecosystems
- Post-fire salvage logging has numerous ecological ramifications. The removal of burned trees that provide shade may hamper tree regeneration, especially on high-elevation or dry sites (Perry et al.1989).The loss of future soil organic matter is likely to translate into soils that are less able to hold moisture (Jenny 1980), with implications for soil biota, plant growth (Rose et al.2001, Brown et al. 2003), and stream flow (Waring and Schlesinger 1985). Logging and associated roads carry a high risk of spreading non-indigenous, weedy species (CWWR 1996, Beschta et al. 2004).
- Increased runoff and erosion alter river hydrology by increasing the frequency and magnitude of erosive high flows and raising sediment loads. These changes alter the character of river channels and harm aquatic species ranging from invertebrates to fishes (Waters 1995).
- Construction and reconstruction of landings (sites to which trees are brought, stacked, and loaded onto trucks) often accompany post-fire salvage logging. These activities damage soils, destroy or alter vegetation, and accelerate the runoff and erosion harmful to aquatic systems.
- By altering the character and condition of forest vegetation, salvage logging after a fire changes forest fuels and can increase the severity of subsequent fires (CWWR 1996, Odion 2004).

Baker Addendum Attachment #2-4:

Lacy, Peter M., 2001. **Our Sedimentation Boxes Runneth Over: Public Lands Soil Law as the Missing Link in Holistic Natural Resource Protection.** Environmental Law; 31 Envtl. L. 433 (2001)

From the Abstract:

Soil is a critical component to nearly every ecosystem in the world, sustaining life in a variety of ways- from production of biomass to filtering, buffering and transformation of water and nutrients. While there are dozens of federal environmental laws protecting and addressing a wide range of natural resources and issues of environmental quality, there is a significant gap in the protection of the soil resource. Despite the critical importance of maintaining healthy and sustaining soils, conservation of the soil resource on public lands is generally relegated to a diminished land management priority. Countless activities, including livestock grazing, recreation, road building, logging, and mining, degrade soils on public lands. This article examines the roots of soil law in the United States and the handful of soil-related provisions buried in various public land and natural resource laws, finding that the lack of a public lands soil law leaves the soil resources under protected and exposed to significant harm. To remedy this regulatory gap, this article sketches the framework for a positive public lands soil protection law. This article concludes that because soils are critically important building blocks for nearly every ecosystem on earth, a holistic approach to natural resources protection requires that soils be protected to avoid undermining much of the legal protection afforded to other natural resources.

The article goes on:

As federal agencies focus increasingly on addressing environmental protection from an holistic perspective under the current regime of environmental laws, a significant gap remains in the federal statutory scheme: protection of soils as a discreet and important natural resource. Because soils are essential building blocks at the core of nearly every ecosystem on earth, and because soils are critical to the healthy of so many other natural resources- including, at the broadest level, water, air, and vegetation- they should be protected at a level at least as significant as other natural resources. Federal soil law (such as it is) is woefully inadequate as it currently stands. It is a missing link in the effort to protect the natural world at a meaningful and effective ecosystem level. This analysis concludes that the lack of a public lands soil law leaves the soil resource under- protected and exposed to significant harm, and emasculates the environmental protections afforded to other natural resources.

FS RESPONSE TO SEXTON #15 and Baker Addendum Attachment #2-4 and #1-4 :

The Forest Service acknowledges the negative impacts of salvage logging on soil functions and quantifies these impacts using monitoring and relevant science. Desired conditions for soil stability, soil organic matter, and soil structure will not be met on a small percentage of the project area due to activities including temporary road use, landing construction, and log skidding. For the action alternatives, implementation of PDFs will reduce the potential for negative effects from soil disturbing activities. Alternatives 2 and 3 will maintain adequate soil cover, protect soil organic matter, and maintain soil structure at levels sufficient to protect soil productivity and prevent soil erosion. The acres that do not meet desired conditions will be minor compared to the total treatment acres in the project. Enacting new soil legislation is outside of the scope of this project.

Sexton Attachment #16 and Baker Addendum Attachment #2-1:

DellaSala, Dr. Dominick A., Ph.D. September 2006. **Post-disturbance literature review for the National Center for Conservation Science & Policy.**

"Post-disturbance recovery, much like fire itself, has been the subject of intense debate and widespread misunderstanding regarding how and whether to treat regenerating landscapes following large disturbance events. As HR4200 – the Forest Emergency Recovery and Research Act – heads to the Senate for debate, it is important that lawmakers and land managers consider the latest science in making informed decisions about the management of public lands following natural disturbances. Numerous scientific studies have demonstrated that natural disturbances, even very large ones such as volcanic eruptions, wildfires, and severe wind storms, are critical to the health of terrestrial and aquatic ecosystems as they are characterized by unique biological communities and generate important structural elements that forests depend on for decades to centuries. The standing dead, dying, and downed trees (especially large ones) and surviving green and scorched ones transfer their critical functions from the pre-disturbed forest to the regenerating one. When post-disturbance "salvage logging" removes these important forest elements, it sets back recovery triggering ecosystem damages that may exceed the impact of the initial disturbance itself.

Based on a review of approximately 38 scientific studies on post-fire logging and additional government reports published to date, not a single study indicated that logging benefits ecosystems regenerating after natural disturbance. In fact, post-fire logging impedes regeneration when it compacts soils, removes "biological legacies" (e.g., large dead standing and downed trees), introduces or spreads invasive species, causes soil erosion when logs are dragged across steep slopes, and delivers sediment to streams from logging roads. With post-disturbance logging these impacts occur when forest recovery is most vulnerable to the effects of additional, especially anthropogenic disturbances, creating cumulative effects that exceed logging of undisturbed forests. Such effects can extend for a century or more, because of the removal of long-persisting and functioning wood legacies.

These findings are especially relevant to public lands policy and management as post disturbance logging currently generates ~40 percent of the timber volume on Forest Service lands nation-wide (USFS Washington Office, timber volume spread sheets -Timber Management Staff, 2005 statistics). Therefore, the following conclusions were provided to assist decision makers regarding post-disturbance management decisions: (1) post disturbance landscapes should be allowed to regenerate naturally as evidence from several locations (Biscuit fire (sw Oregon), Storrie and Starr fires (California Sierras), Yellowstone 1988 fires, Mt. St. Helens eruption, New England hurricanes and insect infestations) indicates recovery can be surprisingly swift and many species that colonize disturbed areas are adapted to them, contributing to recovery in unique ways; (2) road building (even temporary roads)damages regenerative processes in terrestrial and aquatic ecosystems and should be avoided; (3) natural disturbances are characterized by unique biological legacies (large dead and dying trees) essential to regenerative processes – recovery is not possible in their absence; and (4) if salvage logging is to take place for economic reasons, large trees should be retained to protect their biological legacy functions and "no harvest zones" established on steep slopes with fragile soils, including areas of conservation and public health concern such as late successional and old-growth forests, riparian areas, aquatic watersheds essential to drinking water municipalities, and roadless areas.

FS Response to Sexton Attachment #16 and Baker Addendum Attachment #2-1:

As part of the Salmon Salvage Project, the Forest Service will leave many acres that were burned in the Salmon River Complex untreated. Numerous large snags will remain on the landscape within the untreated acres. Though the number of snags varies for each alternative, all alternatives for this project meet Forest Plan guidelines for snag retention and will ensure that this component is also represented in treated stands. See project design features described chapter 2 of the EA.

The Forest Service agrees that a multitude of plants, animals and other life will again colonize the disturbed areas within the fire. Many acres of the area burned in the fire would be left to progress without management. The purpose of the Salmon Salvage Project is to provide for public and forest work safety, recover economic value from burned timber, and increase the speed and likelihood of conifer regeneration. The Proposed Action was fully analyzed and was designed to reduce ecological impacts while achieving long-term goals.

Short-term adverse effects to soils from logging ground-disturbing activities are well documented. The Salmon Salvage Project includes design features and best management practices to minimize adverse impacts to soil and vegetation resources. Using existing skid trails and road templates will reduce the potential ground disturbance area.

Sexton Attachment #17a:

Clark, Darren, Master's Thesis in Wildlife Science, 2007. **Demography and Habitat Selection of Northern Spotted Owls in Post-Fire Landscapes of Southwestern Oregon.**

"Nesting, roosting and foraging habitat with low, moderate, or high severity burn was selected as habitat by spotted owls in post-fire landscapes. Furthermore, roosting and foraging habitat with a moderate severity burn was also selected. These habitats were used in a similar manner to early seral forests including: roosting and foraging habitat with low or high severity burn and salvage logged areas. Non-habitat was the only habitat that was avoided."

Sexton Attachment #17b:

Clark et. al. 2013. **Relationship Between Wildfire, Salvage Logging, and Occupancy of Nesting Territories by Northern Spotted Owls.** The Journal of Wildlife Management.

"Furthermore, Timbered Rock had a 64% reduction in site occupancy following wildfire (2003– 2006) in contrast to a 25% reduction in site occupancy at South Cascades during the same time period. This suggested that the combined effects of habitat disturbances due to wildfire and subsequent salvage logging on private lands negatively affected site occupancy by spotted owls. In our second analysis, we investigated the relationship between wildfire, salvage logging, and occupancy of spotted owl territories at the Biscuit, Quartz, and Timbered Rock burns from 2003 to 2006. Extinction probabilities increased as the combined area of early seral forests, high severity burn, and salvage logging increased within the core nesting areas (^b ¼ 1:88, 95% CI ¼ 0.10–3.66). We were unable to identify any relationships between initial occupancy or colonization probabilities and the habitat covariates that we considered in our analysis where the b coefficient did not overlap zero. We concluded that site occupancy of spotted owl nesting territories declined in the short term following wildfire, and habitat modification and loss due to past timber harvest, high severity fire, and salvage logging jointly contributed to declines in site occupancy."

FS Response to SEXTON #17a,b:

Clark (Clark, 2007) determined that owls were present in severely burned areas but did not determine that these areas were suitable habitat for nesting, roosting or long term occupation by spotted owls. The burned areas may have contained individual features providing a short-term structure for either roosting or foraging but were not suitable for long-term sustainability of a given owl or owl pair.

Sexton Attachment #18:

Bond et. al. 2002. **Short-term effects of wildfires on spotted owl survival, site fidelity, mate fidelity, and reproductive success.** Study published in the Wildlife Society Bulletin.

"The effects of wildfire on wildlife are important considerations for resource managers because of recent interest in the role of fire in shaping forested landscapes in the western United States. This is particularly true of wildfire effects on spotted owls because of the uncertainty of impacts of controlled burning within spotted owl habitat. Therefore, we documented minimum survival, site fidelity, mate fidelity, and reproductive success for 21 spotted owls after large (>540 ha) wildfires occurred within 11 owl territories in California, Arizona, and New Mexico. In each territory, fire burned through the nest and primary roost sites. Eighteen owls (86%) were known to be alive at least 1 year after the fires, which was similar to reported annual adult survival probabilities for the species. Of 7 pairs, of which both members were later re-sighted, all were located together on the same territories during the breeding season following fires, and 4 pairs produced a total of 7 fledglings.

No pair separations were observed after fire. On 8 territories where fire severities were mapped, 50% experienced predominately low- to moderate- severity fires while 50% experienced high-severity fires that burned large (>30%) area of the territories. We hypothesize that wildfires may have little short-term impact on survival, site fidelity, mate fidelity, and reproductive success of spotted owls."

Sexton Attachment #20:

Bond et. al. 2009. **Habitat Use and Selection by California Spotted Owls in a Post-fire Landscape.** The Journal of Wildlife Management.

"Forest fire is often considered a primary threat to California spotted owls because fire has the potential to rapidly alter owl habitat. We examined effects of fire on 7 radio-marked California spotted owls from 4 territories by quantifying use of habitat for nesting, roosting, and foraging according to severity of burn in and near a 610-km2 fire in the southern Sierra Nevada, California, USA, 4 years after fire. Three nests were located in mixed-conifer forests, 2 in areas of moderate-severity burn, and one in an area of low-severity burn, and one nest was located in an unburned area of mixed-conifer–hardwood forest. For roosting during the breeding season, spotted owls selected low-severity burned forest and avoided moderate- and high-severity burned areas; unburned forest was used in proportion with availability. Within 1 km of the center of their foraging areas, spotted owls selected all severities of burned forest and avoided unburned forest. Beyond 1.5 km, there were no discernable differences in use patterns among burn severities. Most owls foraged in high severity burned forest more than in all other burn categories; high-severity burned forests had greater basal area of snags and higher shrub and herbaceous cover, parameters thought to be associated with increased abundance or accessibility of prey. We recommend that burned forests within 1.5 km of nests or roosts of California spotted owls not be salvage-logged until long-term effects of fire on spotted owls and their prey are understood more fully."

FS Response to #18 and #20:

Both of the above documents are included in the analysis and referenced in the wildlife specialist report and the wildlife BA.

Sexton Attachment #19:

Attached are several news articles about the significant scientific controversy surrounding post-fire management. We incorporate these documents into our comments and into the administrative record for the Mt. Hebron [Project]:

- In Fire's Wake, Logging Study Inflames Debate; University Study Challenges
- Cutting of Burnt Timber, The Washington Post, February 27, 2006, p.A3.
- In Bed with Big Wood, Willamette Week, April 19, 2006.
- Logging and Fire Debate Grows, Corvallis Gazette-Times, February 25, 2006
- Wildfire Logging Debate Heats Up, The Scientist, January 27, 2006.
- Logging Study Sets Off Own Firestorm, The Oregonian, January 20, 2006.
- A Student's Forest Paper Sparks One Hot Debate, L.A. Times, June 11, 2006.

FS RESPONSE TO SEXTON #19:

The six articles included in this attachment (#19) are newspaper articles, opinion-editorial pieces, or other types of information that are not considered peer-reviewed scientific papers, nor are they authored by a subject matter expert in the field. As such, they do not comment specifically on the Salmon River Complex area, and are not relevant to the analysis for the Salmon Salvage Project. As stated previously, the Forest Service acknowledges that there is a large amount of information available about the positive effects of wildfires and the potential negative effects from post-fire logging. The "scientific controversy" referred to in these articles has been addressed in response to other articles in this Literature Review.

Sexton Attachment #22 and Baker Addendum Attachment #2-3:

Shatford, Hibbs, Puettmann, 2007. **Conifer Regeneration After Forest Fire in the Klamath Siskiyous: How Much, How Soon?** Journal of Forestry.

The increasing frequency and extent of forest fires in the western United States has raised concerns over postfire management actions on publically owned forests. Information on ecosystem recovery after disturbance is lacking and has led to heated debate and speculation regarding the return of forest vegetation after disturbance and the need for management actions. One critical question emerges, will these ecosystems recover on their own, and if so, over what time frame. We report on one aspect of recovery, the spatial and temporal variation of natural conifer regeneration evident 9-19 years after forest fires in California and Oregon. In contrast to expectations, generally, we found natural conifer regeneration abundant across a variety of settings. Management plans can benefit greatly from using natural conifer regeneration but managers must face the challenge of long regeneration periods and be able to accommodate high levels of variation across the landscape of a fire.

FS RESPONSE TO SEXTON #22 Baker Addendum Attachment #2-3:

The Forest Service is not implying that natural regeneration will not reforest high intensity fire areas. The Forest is proof of that. It is a matter of scale, timing and distance from a conifer seed source. Seedling stocking density can be quite variable and slow with natural regeneration. Planting seedlings from site-specific seed sources after a wildfire does not adversely affect genetic diversity (Rajora and Plujar 2004) and may hasten the return to a large-conifer- dominated forest ecosystem by as much as 50 years (Sessions, Bettinger, Buckman, & Hamann, 2004).Also as stated "managers must be able to face the challenge of long regeneration periods and be able to accommodate high levels of variation across the landscape of a fire." Shatford, Hibbs, & Puettman, 2007 does not meet the requirements of many land allocation standards and guidelines.

Sexton Attachment #23:

Donato et al., 2009. **Vegetation Response to a Short Interval Between High-Severity Wildfires in a Mixed-Evergreen Forest .** Journal of Ecology. 2009, Volume 97. 142-154.

Summary:

1. Variations in disturbance regime strongly influence ecosystem structure and function. A prominent form of such variation is when multiple high-severity wildfires occur in rapid succession (i.e. short-interval (SI) severe fires, or 're-burns'). These events have been proposed as key mechanisms altering successional rates and pathways.

2. We utilized a natural experiment afforded by two overlapping wildfires occurring within a15- year interval in forests of the Klamath–Siskiyou Mountains, Oregon (USA). We tested for unique effects of a SI fire (15-year interval before 2002 fire) by comparing vegetation communities 2 years post-fire to those following a long-interval (LI) fire (> 100-year interval before 2002 fire) and in mature/old-growth (M/OG) stands (no high-severity fire in > 100-year).

3. Nearly all species found in M/OG stands were present at similar relative abundance in both the LI and SI burns, indicating high community persistence through multiple high-severity fires. However, the SI burn had the highest species richness and total plant cover with additions of disturbance-associated forbs and low shrubs, likely due to a propagule bank of early seral species that developed between fires. Persistence of flora was driven by vegetative sprouting, on-site seed banks, and dispersal from off-site

seed sources. Several broadly generalizable plant functional traits (e.g. rapid maturation, long-lived seed banks) were strongly associated with the SI burn.

4. Sprouting capacity of hardwoods and shrubs was unaltered by recurrent fire, but hardwood/shrub biomass was lower in the SI burn because individuals were smaller before the second fire. Conifer regeneration densities were high in both the SI and LI burns (range = 298–6086 and 406–2349 trees ha., respectively), reflecting similar availability of seed source and germination substrates.

5. Synthesis. SI severe fires are typically expected to be deleterious to forest flora and development; however, these results indicate that in systems characterized by highly variable natural disturbances (e.g. mixed-severity fire regime), native biota possess functional traits lending resilience to recurrent severe fire. Compound disturbance resulted in a distinct early seral assemblage (i.e. interval-dependent fire effects), thus contributing to the landscape heterogeneity inherent to mixed-severity fire regimes. Process-oriented ecosystem management incorporating variable natural disturbances, including 'extreme' events such as SI severe fires, would likely perpetuate a diversity of habitats and successional pathways on the landscape.

FS RESPONSE TO SEXTON #23:

This project leaves some areas untreated, including areas of moderate and high burn severity. None of the land in the Inventoried Roadless Area will be treated with this project, as well as many acres outside the Inventoried Roadless Area. About 2.2% of the public lands within the burn perimeter are within the salvage treatment units.

The Donato et al. (2009) paper addresses the development of the vegetation community following reoccurring fires. In conclusion they state:

> Post fire management are often focused, in part, on reducing adverse effects of repeat high severity fires (expectation of model 2; USDA 1988). For certain objectives, such as the rapid attainment of late-successional condition, recurrent stand-replacement fires are clearly counterproductive in the short term. However, these events may be consistent with objectives for maintaining characteristic disturbance processes and regional vascular plant diversity (see Landers et al. 1999). These results indicate that much of the native biota is resilient to 'extreme' events such as recurrent severe fire. Given the Klamath-Siskiyou region's characteristic patterns of fire severity, productivity, and ignition source, there is good reason to believe that the short-interval severe fires have historically been a component of the fire regime. These events contribute to the landscape heterogeneity inherent to mixed severity fire regimes, in which variability in fire frequency, severity, and pattern can be more important than central tendencies (Agee 2005). Where consistent with land use objectives, process-based disturbance management could include this variation, perpetuating a diversity of conditions across the landscape.

However, a significant portion of this project occurs within the WUI of Sawyers Bar. The objectives of this area are more in line with a LI fire regime than a SI one. There are many areas of the Forest where the SI model is actively occurring (i.e. the Marble Mountains Wilderness Area—Uncles fire, Hancock fire and Jakes fire in the past 15 years), therefore representing that diversity across the landscape in this paper.

Sexton Attachment #24 Baker Addendum Attachment #1-1:

Lee., 2012. **Dynamics of Breeding-Season Site Occupancy of the California Spotted Owl in Burned Forests.** The Condor 114(4): 792-802, The Cooper Ornithological Society 2012.

Summary:

1. Variations in disturbance regime strongly influence ecosystem structure and function. A prominent form of such variation is when multiple high-severity wildfires occur in rapid succession (i.e. short-interval (SI) severe fires, or 're-burns'). These events have been proposed as key mechanisms altering successional rates and pathways.

2. We utilized a natural experiment afforded by two overlapping wildfires occurring within a15- year interval in forests of the Klamath–Siskiyou Mountains, Oregon (USA). We tested for unique effects of a SI fire (15-year interval before 2002 fire) by comparing vegetation communities 2 years post-fire to those following a long-interval (LI) fire (> 100-year interval before 2002 fire) and in mature/old-growth (M/OG) stands (no high-severity fire in > 100-year).

3. Nearly all species found in M/OG stands were present at similar relative abundance in both the LI and SI burns, indicating high community persistence through multiple high-severity fires. However, the SI burn had the highest species richness and total plant cover with additions of disturbance-associated forbs and low shrubs, likely due to a propagule bank of early seral species that developed between fires. Persistence of flora was driven by vegetative sprouting, on-site seed banks, and dispersal from off-site seed sources. Several broadly generalizable plant functional traits (e.g. rapid maturation, long-lived seed banks) were strongly associated with the SI burn.

4. Sprouting capacity of hardwoods and shrubs was unaltered by recurrent fire, but hardwood/shrub biomass was lower in the SI burn because individuals were smaller before the second fire. Conifer regeneration densities were high in both the SI and LI burns (range = 298–6086 and 406–2349 trees ha., respectively), reflecting similar availability of seed source and germination substrates.

5. Synthesis. SI severe fires are typically expected to be deleterious to forest flora and development; however, these results indicate that in systems characterized by highly variable natural disturbances (e.g. mixed-severity fire regime), native biota possess functional traits lending resilience to recurrent severe fire. Compound disturbance resulted in a distinct early seral assemblage (i.e. interval-dependent fire effects), thus contributing to the landscape heterogeneity inherent to mixed-severity fire regimes. Process-oriented ecosystem management incorporating variable natural disturbances, including 'extreme' events such as SI severe fires, would likely perpetuate a diversity of habitats and successional pathways on the landscape.

Forest fires, particularly high-severity fire, is generally presumed to reduce occupancy by California Spotted Owls, on the basis of modifications to the forest canopy, basal area of live trees, and other vegetation and habitat elements. Our results do not support this presumption and instead corroborate and elaborate on previous studies of the Spotted Owl that found occupancy not diminished by forest fires of varying severities (Bond et al. 1001, Jenness et al. 2004, Roberts et al. 2011). We found no significant effects of fire on occupancy dynamics for up to 7 years post-fire and for the vegetation conditions of the sites in our study.

FS RESPONSE TO SEXTON #24 and Baker Addendum Attachment #1-1:

This paper discusses use of California spotted owl in habitat areas burned at high severity, as opposed to the northern spotted owl (NSO) found on the Klamath National Forest. Our assumption is that high severity burned areas to be salvaged will not provide long-term suitable habitat (*Silviculture Report* and *Terrestrial Wildlife Report*, effects section). Important habitat components such as large snags will be retained in clumps and skip throughout the salvage treatments to provide for future habitat quality for NSO.

Sexton Attachment #25b:

Franklin, Johnson, 2012**. A Restoration Framework for Federal Forests in the pacific Northwest .** Journal of forestry, 2012 Volume 110(8:429-439.

Statement:

“Theoretically, disturbances of either natural (e.g., wildfire) or human (e.g., timber harvest) origin are capable of generating this stage. Large natural disturbances often produce high-quality early seral ecosystems provided they are not intensively salvaged and replanted (Swanson et al. 2011), but such disturbances are poorly distributed in time and space. For example, less than 1% of suitable NSO habitat (complex forest) was transformed by wildfire into early successional habitat between 1996 and 2006 in MF-dominated provinces of the Northwest Forest Plan (NWFP; USDI Fish and Wildlife Service 2011). Areas devoted to intensive timber production generally provide little high- quality early seral habitat for several reasons. First, few or no structures from the preharvest stand (e.g., live trees, snags,and logs) are retained on intensively managed sites but are abundant after severe natural disturbances (Swanson et al. 2011). Additionally, intensive site preparation and reforestation efforts limit both the diversity and the duration of early seral organisms, which may also be actively eliminated by use of herbicides or other treatments (Swanson et al. 2011). Consequently, many MF landscapes currently lack sufficient representation of high-quality early seral ecosystems because of harvest, reforestation, and fire suppression policies on both private and public lands (Spies et al. 2007, Swanson et al. 2011).”

FS RESPONSE TO SEXTON #25b:

Franklin and Johnson’s A *Restoration Framework for Federal Forests in the Pacific Northwest* describes management practices for either dry or moist forests in the Pacific Northwest. The statement is taken from the section entitled “Characteristics and Current State of MF’s (Moist Forests)”. The paper describes moist and dry forests in two ways: First, fire return interval, and second, plant association series. Fire return interval for dry forests ranges from three to 35 years, while fire return interval for moist forests can be from one to several centuries. The fuels report states that the fire return interval for this area is about 11.5 to 16.5 years, well within the dry forest range. The plant association series for the project area would fall into one of the two following series: Ponderosa pine (*Pinus ponderosa*) series or Douglas-fir (*Pseudotsuga menziesii*) series. These are both classified as dry forest plant association series. Since the project area is considered a dry forest as described by the paper, these statements do not apply to the project area.

Sexton Attachment #25a:

Swanson et al., 2009. **The Forgotten Stage of Forest Sucession: Early-Successional Ecosystems on Forest Sites**. Frontiers in Ecology and the Environment. 2010.

Summary:

The ecological differences between biologically rich stands that result from natural disturbance and stands that are subject to logging and yarding are well-known and established: Early-successional forest ecosystems that develop after stand-replacing or partial disturbances are diverse in species, processes, and structure. Post-disturbance ecosystems are also often rich in biological legacies, including surviving organisms and organically derived structures such as woody debris. These legacies and post-disturbance plant communities provide resources that attract and sustain high species diversity, including numerous early-successional obligates, such as certain woodpeckers and anthropods. Early succession is the only period when tree canopies do not dominate the forest site, and so this stage can be characterized by high productivity of plant species (including herbs and shrubs), complex food webs, large nutrient fluxes, and high structural and spatial complexity. Different disturbances contrast markedly in terms of biological legacies, and this will influence the resultant physical and biological conditions, thus affecting successional pathways. Management activities, such as post-disturbance logging and dense tree planting, can reduce the richness within and the duration of early-successional ecosystems. Where maintenance of biodiversity is an objective, the importance *and value of these natural early- successional ecosystems are underappreciated.*

FS RESPONSE TO SEXTON #25a:

The referenced literature speaks to the value of early seral forest ecosystems and the effects of salvage logging and follow up planting on the longevity of such ecosystems. The Klamath National Forest recognizes the importance of these ecosystems on the landscape. A watershed assessment for the North Fork of the Salmon River provides desired conditions for seral stages across the watershed. Desired conditions for early seral forest ecosystems range between 5-20% (USFS 1995, page 5-9). Based on existing vegetation data and vegetative burn severity data from the Salmon River Complex, the existing condition of early seral forest ecosystems within the fire perimeter is about 41%. Salvage logging and follow up reforestation activities prescribed in the Salmon Reforestation Project would accelerate a very small amount of the early seral condition, but overall would increase the diversity of seral stages and move it more in line with the desired condition for the landscape.

Baker Addendum Attachment #2-5:

Marañón-Jiménex, Sara, Jorge Castro, Emilia Fernádex-Ondono and Regino Zamora. **Charred Wood Remaining after a Wildlife as a Reservoir of Macro- and Micronutrients in a Mediterranean Pine Forest.** International Journal of Wildland Fire. CSIRO Published 2013.

From the abstract:

Large amounts of logs and coarse woody debris remain in the ecosystem after wildfires. However, the relevance of the nutrient reservoir contained in the remaining post-fire woody debris for the ecosystem nutrient reserves is rarely considered. In this paper, we determine the carbon and nutrient concentrations in the partially charred wood after a wildfire along an altitudinal gradient and assess the relative magnitude of the nutrient reservoir in the wood in relation to those existing in the first 10-cm soil layer. Soils were poorly developed and nutrients limiting for the vegetation requirements. Charred woody material still contained a relatively high concentration of nutrients compared to those reported for unburnt pine wood, and in general, this decreased with altitude. Partially charred wood represented a considerable pool of nutrients, due to both the relatively high concentrations and to the great amount of biomass still present after the fire. Potential contributions of the charred wood were particularly relevant for N and micronutrients Na, Mn, Fe, Zn and Cu, as wood contained 2-9 times more nutrients than the soil. Post-fire woody debris constitutes therefore a valuable natural element as a potential source of nutrients, which would be lost from ecosystems in cases where it is removed.

Conclusion:

The partially charred wood remaining after a forest fire still contains great amounts of nutrients, and therefore represents a valuable reservoir as well as a potential source for the regenerating ecosystem in the longer term. In this study , the magnitude of these stocks was especially prominent in the case of N and the macronutrients Na, Mn, Fe, Zn, and CU, where stocks in the burnt wood were higher than those existing in the upper 10-cm of soil litter. Moreover, the relevance of wood as a potential nutrient source coincided with those nutrients that were deficient to satisfy the requirements of a mature forest. Therefore the suitability of the remaining wood debris after fires for the nutrient capital of the ecosystem should be considered for post-fire management of burnt areas.

FS RESPONSE TO Baker Addendum Attachment #2-5:

The Forest Service agrees with the conclusion that partially charred wood remaining after a forest fire represents a reservoir of nutrients for soil fertility but contend that the scope of nutrient loss resulting from the proposed salvage logging will not be significant. The measured soil nutrient capital in this study does not represent the conditions of the Salmon Salvage Project. This study found low levels of soil nutrients in the upper 10cm of mineral soil on sites that have a recurrent history of degrading land use. Compared to this study, soil nutrients near the Salmon Salvage Project have been measured at higher levels. Additionally, by only accounting for nutrients in the upper 10cm of mineral soil, this study underestimates the total nutrient capital in the ecosystem.

Unlike this study that presumes that all woody material will be removed from the site, the Salmon

Salvage Project has been designed to leave organic material to provide for soil productivity. Nutrients from logging slash, trees left on site that are too small to salvage log, trees left on site in Riparian Reserves, and trees left for wildlife habitat will all contribute to the nutrient capital from woody material in the near and short term.

Baker Addendum Attachment #2-6:

Moisset, Ph.D. Beatriz, Buchmann, Ph.D. Stephen. **Bee Basics- An Introduction to our Native Bees**. USDA 2011.

Standing dead trees are important nesting habitats for 30% of our native bees.

FS RESPONSE TO Baker Addendum Attachment #2-6:

Creating habitat for bees is outside of the scope of this project.

Baker Addendum Attachment #1-2:

Hanson, Odion, Dellasala and Baker. 2009. **Overestimation of Fire Risk in the Northern Spotted Owl Recovery Plan.** Conservation Biology.

“Moreover, patches of high severity fire will not necessarily cause a decrease in spotted owls or their habitats.”

FS RESPONSE TO Baker Addendum Attachment #1-2:

The document referenced speaks to the overestimation of fire risk in the Northern spotted owl recovery plan as it was published in 2008. Since that time the United States Department of Interior has revised the recovery plan (2011). This project is not referring to the risk of wild fire to drive actions, rather it is responding to the effects of a wildfire. It is outside of the scope of the project to modify the recovery plan. The Klamath National Forest Land and Resource Management Plan page 4-6 directs the forest to be consistent with recovery plans for individual species.

Baker Addendum Attachment #1-3:

Bond, M., R.B. Siegel, R.L. Hutto, V.A. Saab, S.A. Shunk. 2012. **The Need For High Severity Fires**. The Wildlife Professional, Winter 2012, Pg. 46-49.

“The ability to use severely burned forests even extends to some unlikely characters, including the spotted owl (*Strix occidentalis)*, the classics poster- child for dense, old-growth forests. Spotted owls tend to nest and roost in forests with dense canopies and larger trees, but they benefit from fires that create more open habitat patches ideal for hunting prey (Bond et al. 2009). Spotted owls have relatively large territories, and they will occupy areas containing high- severity burns, as long as some unburned or lightly burned habitat remains for nesting and roosting (Bond et al. 2002, Jenness et al. 2004, Roberts et al. 2011, Lee et al. 2012).”

FS RESPONSE TO Baker Addendum Attachment #1-3:

This paper appears to compile several ideas and research articles with no study area or methodology. The paper does not provide recommendations for management, but rather speaks to the importance of the habitat that moderate and high severity burns create. The Forest Service recognizes the value to post fire landscapes of these fire adapted ecosystems. This is why only 330 acres of the possible 1,440 acres that burned at moderate or high severity are proposed for salvage treatment. More than 75% of the land in this condition will remain untreated.

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